Patient's Subjective Impression of Cervical Range of Motion: A Mixed-methods Approach

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Abstract: STUDY DESIGN Mixed-method. OBJECTIVE To evaluate the association between objective and subjective cervical range of motion (ROM) among patients with neck pain, and to assess the awareness of impairments. SUMMARY OF BACKGROUND DATA Cervical ROM is frequently used to evaluate neck pain, but it is also important to know what a patient expects from treatment, because this can profoundly affect treatment outcomes and patient satisfaction. METHODS We used a cervical ROM instrument, the Neck Disability Index (NDI), and a self-administered ROM questionnaire for the neck (S-ROM-Neck). Ten patients took part in semi-structured interviews. Correlations were analyzed using Spearman rank order correlations (rs). Differences between patient and assessor were evaluated by the Mann-Whitney U test. Qualitative data were analyzed by content analysis. RESULTS Thirty participants (mean age 43.80 years; 21 females) were included. The correlation (rs) for the S-ROM-Neck between patient and assessor was 0.679 [95% confidence interval (95% CI) 0.404-0.884; P = 0.000]. The correlation between the NDI and S-ROM-Neck was 0.178 (95% CI -0.233 to -0.533; P = 346) for the assessor and -0.116 (95% CI -0.475 to -0.219, P = 0.541) for the patient (U = 448, z = -0.030, P = 0.976). Qualitative analysis revealed that patients had general restrictions in daily life and with specific movements, but that they adjusted their behavior to avoid impairment. CONCLUSION There was a significant correlation between patient and therapist ratings of cervical spine mobility. Although patients experience restriction while moving and are impaired in specific activities, they adjust their lifestyle to accommodate their limitations. LEVEL OF EVIDENCE 4.

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Patient`s subjective impression of cervical range of motion: A mixed-methods approach

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Abstract

Study Design: Mixed-method.

Objective: To evaluate the association between objective and subjective cervical range of motion (ROM) among patients with neck pain, and to assess the awareness of impairments.

Summary of Background Data: Cervical ROM is frequently used to evaluate neck pain, but it is also important to know what a patient expects from treatment, because this can profoundly affect treatment outcomes and patient satisfaction.

Methods: We used a cervical ROM instrument, the Neck Disability Index (NDI), and a self-administered ROM questionnaire for the neck (S-ROM-Neck). Ten patients took part in semi-structured interviews. Correlations were analyzed using Spearman rank order correlations (r_s). Differences between patient and assessor were evaluated by the Mann–Whitney *U* test. Qualitative data were analyzed by content analysis.

Results: Thirty participants (mean age 43.80 years; 21 females) were included. The correlation (r_s) for the S-ROM-Neck between patient and assessor was 0.679 (95% confidence interval [95%CI] 0.404–0.884 p = 0.000). The correlation between the NDI and S-ROM-Neck was 0.178 (95%CI −0.233 to -0.533; p = 346) for the assessor and −0.116 (95%CI −0.475 to −0.219, p = 0.541) for the patient ($U = 448$, $z = -0.030$, p = 0.976). Qualitative analysis revealed that patients had general restrictions in daily life and with specific movements, but that they adjusted their behavior to avoid impairment.

Conclusion: There was a significant correlation between patient and therapist ratings of cervical spine mobility. Although patients experience restriction while moving and are impaired in

specific activities, they adjust their lifestyle to accommodate their limitations.

Key words: Neck pain, cervical range of motion, patient's perspective, impairments, mixed-method, awareness, quantitative, qualitative, interview

Level of Evidence:4

INTRODUCTION

Range of motion (ROM) is used to assess joint movement for treatment, symptom monitoring, and treatment evaluation.[1,2] Cervical ROM (CROM) is specifically assessed for neck problems,[3–7] and includes flexion, extension, lateral flexion (left/right), and rotation (left/right).[7] Although measurements can be taken by various methods (e.g., tape measure or inclinometer),[8–15] it is equally important to know a patient's expectations of treatment,[16,17] because these can affect outcomes and satisfaction.[16] Expectations are unique to an individual, and may be influenced by a multitude of factors.[16,18] To date, there has only been limited research on the patient's perspective, including why they consult doctors and what they think about the different therapies for neck pain.[17] This must be rectified if we are to direct therapy to meet patient needs and expectations, and, ultimately, improve outcomes.[19,20] Therefore, we studied the association between objective CROM restriction and the subjective perspectives of patients and therapists. We also evaluated patient awareness of impaired neck movement and how it limited their activities of daily living (ADLs). We hypothesized that differences would exist in the subjective and objective measures of CROM, and that restricted CROM would not be important to patients until it interfered with their ADLs.

MATERIALS AND METHODS

Patients

We recruited 30 patients with neck pain from physiotherapy practices in Zurich. All patients were referred by a general practitioner or chiropractor. We included patients if they provided informed consent, were older than 18 years, had neck pain (any duration), and could read, speak, and write German. We excluded patients with radiculopathy and disk herniation of the cervical

spine, stenosis of the cervical spinal, acute whiplash disorder, prior cervical spine surgery, or an implanted pacemaker or defibrillator.

Study Design

A mixed-methods approach was used with an explanatory-sequential design.[21] Age, gender, weight, height, diagnosis, comorbidities, medication, duration, and dexterity data were collected. We then performed assessments with the CROM instrument, the Neck Disability Index (NDI), and the Self-administered Range of Motion Questionnaire for the Neck (S-ROM-Neck). Patients were also selected at random for the qualitative study. Mixed-methods research uses a combination of quantitative and qualitative data in response to a research question. This combination of research methods uses the strength from both data sets to understand research problems. The explanatory-sequential design uses the qualitative approach to explain and investigate the data from the quantitative approach more in depth. [22]

Assessments

The CROM instrument

We used a goniometer with established validity and reliability to measure active CROM.[12,23–26] The researcher demonstrated the required movements before each measurement. The subject was asked to undress the upper body, sit erect in a straight-back chair, place the sacrum against the back of the chair but the thoracic spine away from it, and leave their arms hanging at their sides and feet flat on the floor.[27,28] Measurements were taken once in each position, with participants returning to the neutral position for a rest of 5–10 s between movements.

The NDI

The NDI is a self-rated disability questionnaire for assessing neck pain.[29,30] It consists of ten items, such as working and driving, with each item scoring up to five points (total score = 50). The lower the score, the less the self-rated disability.[30] The validity and reliability of a German version have been confirmed.[31]

The S-ROM-Neck questionnaire

The S-ROM-Neck questionnaire was only recently developed, and although its validity and reliability have been assessed, further study is needed (Langenfeld, 2017). It is a self-administered questionnaire that uses visual analog scales (VAS) to measure pain-free active CROM for all neck movements. The patient is asked to place a mark on a 100 mm line (0 mm indicates "no movement possible" and 100 mm indicates "as far as possible"). The result, in millimeters, reflects the patient's ability to move. The reason for restricted movement is also recorded. Rotation and lateral flexion are compared bilaterally. The total score is the sum of the individual scores (min. score (600) = no restrictions and max. score (0) = total restriction). The patient (S-ROM-Neck-P) and the assessor (S-ROM-Neck-A) both filled out the questionnaire. This was done separately but at the same time. The assessor observed the movement done by the patient and rated it on the S-ROM-Neck as did the patient. We compared the S-ROM-Neck results for the patient (S-ROM-Neck-P) and the assessor (S-ROM-Neck-A).

Interviews

We conducted semi-structured interviews,[32] starting with general questions to get an overview of the patient's complaint (e.g., the reason for attendance, the main complaint, and whether the complaint prevented ADLs). The patient and interviewer both completed S-ROM-

Neck questionnaires during the interview, with the interviewer asking whether a movement caused restriction at each point; if it did, the interviewer asked why, and whether it interfered with ADLs. The interview was recorded and afterwards transcribed.

Data Analysis

In the study we combined two ways of data collection, quantitative and qualitative. To have a good explanatory power of the quantitative data 24 patients were needed. A sample of 24 is adequate for a cross-sectional study to provide statistical significant outcome.[33] We planned to use nonparametric tests in the analyzes, therefore we added 15% to the sample size and another two because for potential dropouts. The total number of participants is 30. For the qualitative part, which is used to understand and interpret the quantitative data, 10 interviews with participants were conducted.[22]

Quantitative analyses

The Shapiro–Wilk test was used to assess the normality of the CROM, S-ROM-Neck, and NDI data. To identify correlations between the CROM, NDI, and both S-ROM-Neck scores (assessor and participant), we calculated Spearman rank order correlations (r_s). Coefficients of 1 and −1 indicated perfect positive and negative correlations, respectively.[34] The Mann–Whitney *U* test was used to assess differences in the S-ROM-Neck-P and S-ROM-Neck-A.[35] Significance was set at $p < 0.05$. Average scores were calculated for every item of the NDI when evaluating what ADLs were restricted.

Qualitative analyses (interviews)

Qualitative assessment was done by content analysis, using transcribed interview data. [36–40]

We used content structuring to extract specific interview data, based on pre-determined criteria.[39] The aim was to extract examples for a category framework[41] that could be used to analyze the interviews by establishing coding rules.[41] The interviews were analyzed by two researchers and their findings were compared and discussed.

RESULTS

Quantitative Analysis

We enrolled 30 participants (21 female, 9 male), of whom 27 had chronic neck pain and 3 had acute problems (Table 1). The CROM, S-ROM-Neck, and NDI data were not normally distributed, and all data had a monotonic relationship. Correlations were calculated for the CROM measurements and the S-ROM-Neck-P and the S-ROM-Neck-A (Table 2 and Figure 1). There was good correlation between the S-ROM-Neck-P and the S-ROM-Neck-A (r_s 0.679, 95% confidence interval [95%CI] 0.404–0.884; p = 0.000). The NDI scores correlated with both the S-ROM-Neck-P total score (r_s −0.116, 95%CI −0.475 to 0.219; p = 0.541) and S-ROM-Neck-A total score (r_s 0.178, 95%CI −0.233 to 0.533; p = 0.346). Visual inspection revealed similar score distributions, but no statistically significantly difference in the median total score for S-ROM-Neck-P (473.50) and S-ROM-Neck-A (458.00) (U = 448, z = −0.030; p = 0.976). Single item analysis of the NDI revealed high scores for headaches, recreation, reading, pain intensity, and driving (7 did not drive a car) (Table 3).

Qualitative Analysis

We interviewed six women and four men (Interviewee 1-10); nine had chronic and one had acute neck pain, but all ten were right handed (Table 4).

Reason for seeing a physical therapist

All patients reported neck pain as the main complaint, but also had shoulder pain, headaches, dizziness, nausea, visual impairments, and jaw pain: *"Yes. Exactly. Because of neck pain and shoulder pain but also seeing impairments. Recently I started to have headaches and sometimes nausea, seldom and lightly, but I have it. And pain in the jaw"* (Interviewee 1). One patient was diagnosed with neck pain, but the main complaint was restricted movement, plus blocking and pain: *"Due to restriction of the movement, blocking and pain as well."* (Interviewee 4).

ADL restrictions due to neck pain

Driving a car, sports participation, work, reading, and sleep were typically affected: *"Yes. Moving the left arm during dancing. During singing, I feel a little … everything is so tight around the neck. And during Yoga classes and such things, I cannot move as usual."* (Interviewee 6). Concentration and patience were also affected by the lack of sleep: *"Yes, yes, erm, I am less concentrated at work, and due to the lack of sleep I am less patient with others, yes."* (Interviewee 5). Others had no impairment but the pain:*" I am not really restricted, so… yes, a little, the movement is restricted, but it does not interfere with any of my activities."* (Interviewee 3).

General description of the problem

Pain was most frequently mentioned, together with stiffness, resistance, pressure, pinching or muscle soreness: *"Pain and some pressure, so I … it is pinching me."* (Interviewee 6).

Perception on head movement

Head movement ranged from being no problem at all (*"That is no problem, as far as I want to."*; interviewee 4) to being completely restricted by pain (*"Well, I cannot do it very well. It is painful … and I cannot go any further."*; Interviewee 9). Tightness, stiffness, and blocking were also reported: *"Hmm, it feels as if the muscle is too short on the left side."* (Interviewee 6). One patient reported dizziness and nausea on flexion, extension, and rotation: *"Now, it is causing pain and dizziness … and I am feeling a little bit sick."* (Interviewee 2). Some patients heard a cracking or popping sound during movement: *"It is always related to pain and it is cracking"* (Interviewee 10) and *"I always feel it if I move, then it pops"* (Interviewee 1). Other patients had not done the movement before and said it felt unnatural to execute: "*Yes, so I, it feels restricted to me, but I never do it. Moving my head to the front. I would say I bend forward with my whole body, if needed. I never do this movement. It feels unnatural to me."* (Interviewee 5) and *"Funny, but if you never do it … this is a movement I never do."* (Interviewee 8).

Subjective impression of movement restriction

Flexion and extension subjectively felt least restricted in six patients: *"I am not restricted to move my head forward, that works fine."* (Interviewee 4). However, four felt restricted in flexion: *"Yes, ok. But if I go further, then I have to use a lot of force and it starts to be really painful"* (Interviewee 10). The most restricted movement was left rotation (*"Yes, a little. Because if I would like to turn … I have to turn completely. So, I have to turn my whole body, I cannot do it like this."*; Interviewee 9) followed by right rotation (*"Yes, definitely. So, I think, that a person without my problem will be able to move further, for sure."*; Interviewee 10) and right lateral flexion (*"Yes, I do not think I can go any further"*; Interviewee 10).

ADL limitations due to movement restrictions

ADL limitations were reported for restrictions to flexion, extension, and left and right rotation. Limited flexion impaired the ability to do household chores (e.g., taking things off a shelf), working at a computer, opening a car door, and hobbies (e.g., reading and badminton): *"If you take a pan out of the cupboard… if I open a car door."* (Interviewee 10). Limited extension also impaired household chores, driving, and hobbies: *"More during my spare time. Especially while I dive. When I am looking around I feel it in my neck."* (Interviewee 1). Finally, limited neck rotation affected several ADLs. Driving was one of the most common restrictions: *"Yes, driving a car. Nowadays I use the mirrors."* (Interviewee 9). Participants stated that they rotated the whole body when needing to look to the side in a seat: *"Erm, if I sit in front of a computer and a colleague starts talking to me from the side … I turn my chair to face my colleague."* (Interviewee 5) and *"it is difficult in a restaurant. If my husband tells me to look at someone, I cannot move my head, I have to turn my chair…"* (Interviewee 8). Limited right and left lateral flexion also impaired household chores and work. Some participant stated, that although they had problems with specific movement, they adjusted their behavior so that the restriction did not interfere with activities: *"… I am a little bit slower and careful … to be able to control the movement, so that is does not bother me during my activities."* (Interviewee 3) and *"… but you can definitely live with it."* (Interviewee 8).

DISCUSSION

We showed medium and strong statistically significant correlations between objective and subjective CROM, and that patients judged CROM as well as assessors. However, although patients did report ADL impairment, they also reported effective coping strategies.

Our results for CROM evaluation are comparable with other studies. For one study, our results were similar for flexion but not for extension and rotation.[42] This was possibly because that study only included women, who typically have greater ROM,[43] and excluded participants with psychiatric, vestibular, and dizziness complaints.[42] Patients with neck pain, especially those with acute whiplash disorder, are known to have dizziness and sensorimotor impairments due to disturbed cervical spine receptors,[44,45] so we excluded this group; but, some patients may have had a traumatic neck injury that caused dizziness or vertigo. We used ROM as an outcome measure because current literature suggests that it is restricted in chronic neck pain and that it decreases with age.[42,43,46–48] Normal values for CROM have been reported in asymptomatic participants.[5] In our study, left rotation (20°), right rotation (14°), flexion (12°), and extension (8°) differed most compared with asymptomatic age-matched controls.[5] Finally, patient and assessor CROM ratings were comparable, and the results were statistically significant in all but two cases. Thus, although subjective and objective assessments overlap, the S-ROM-Neck adds complementary information that might affect treatment decisions.

The mean NDI rating indicated that our patients had mild disabilities, but specific problems (e.g., headaches, recreation, reading, pain, and driving difficulties). Although this was confirmed at interviews, patients also reported adjusting their ADLs to limit restriction. Work scored a maximum of 3, but the interview revealed that different aspects of work were impaired more (e.g., communication and reading); again, patients reported adjusting their behavior. Driving also scored a high NDI rating among drivers, although interviews again revealed that patients made adjustments. Although the average NDI ratings were not very high, during the interview patients stated that they experienced ADL restrictions. This might explain the low correlation between the functional NDI scores and the S-ROM-Neck scores. The NDI is meant to

assess pain/functional disability and cognitive functioning,[31] whereas the S-ROM-Neck assesses potentially unrevealed physiological functioning.

Comparable to other studies, the correlation between patient- and assessor-rated CROM was medium to good between movement directions.[49–51] For example, measurements ranged from 0.86 to 0.90 when evaluating mouth opening with a cardboard scale.[49] In that study, the higher correlation probably resulted from proper use, with patients instructed to use the scale in front of a mirror, allowing them to make adjustments.[49] In our study, patients only completed a form and were asked to execute movements as they interpreted them, without instruction or correction. Moreover, sensorimotor control could have been impaired in our patients.[45] Using the elbow self-assessment score,[51] patients also used visual inspection and control to judge their movement based on pictures of the desired movement.[51] However, our results are closer to those published for the Patient's Global Impression of Change and the Clinical Global of Change scales for measuring the perception of change.[50] Although they used Likert-type scales[52] and we used the VAS, both measures rely on the subjective judgment of the user, making it reasonable to compare the correlations.

The interviews revealed that patients were aware of ADL restrictions, but that they denied impairment; instead, patients adjusted, raising the question of whether obvious restrictions that do not interfere with ADLs should be treated. It also confirms that it is important to establish treatment goals with patients, which can ensure active involvement and successful outcomes.[53] Therefore, practitioners should carefully evaluate a patient's needs and goals to ensure focused treatment that does not expose the patient to unnecessary interventions that do not meet his or her goals.[54,55]

Limitations

Warm-up movements have been recommended before measuring ROM in clinical settings,[56] but we did not ask for this because we wanted to mimic normal ADL situations where warm-up movements are unlikely.

We also included more patients with chronic than acute neck pain, limiting our ability to generalize the results. Furthermore the study sample has a low pain level, therefore future studies should include patients with a higher pain levels due to neck pain.

Conclusion

There was a significant correlation between patient and therapist CROM ratings. Although patients experienced movement restrictions and ADL impairments, they adjusted their lifestyles to accommodate those limitations. Considering the patient's perspective in this way gives us an important insight into the extent to which pain is a problem. Including patients in goal setting may improve treatment success and help avoid unnecessary examination and treatment.

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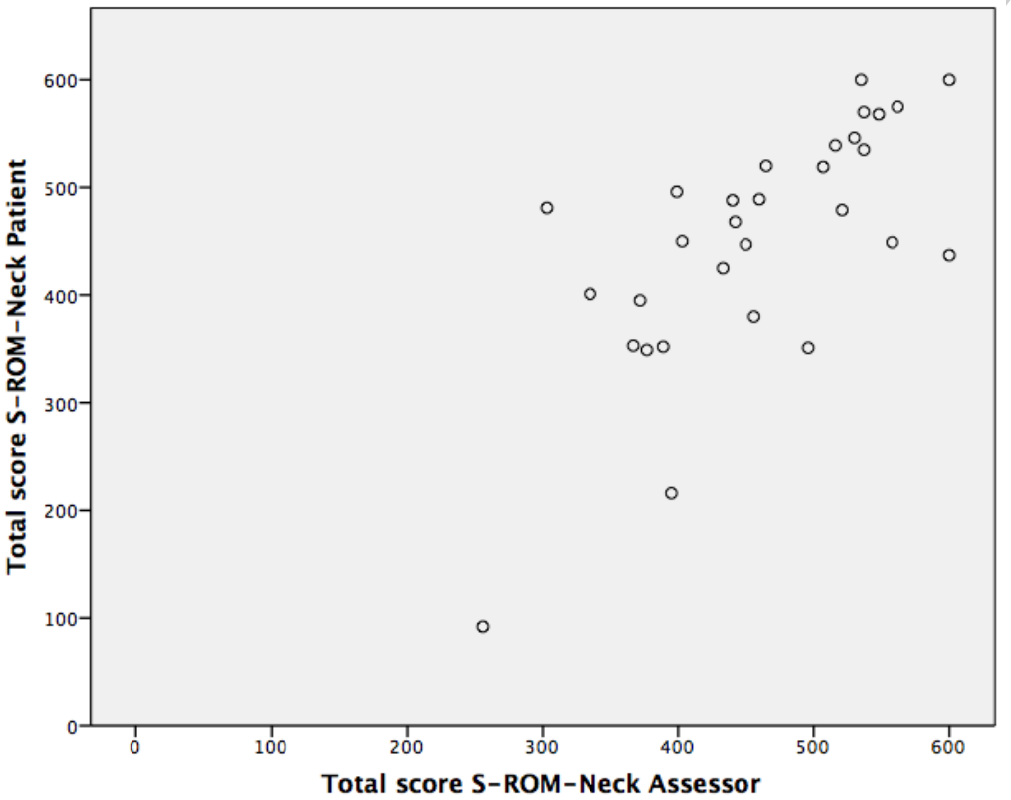
Figure legends

Figure 1. Scatterplot; Correlation of S-ROM-Neck assessor and patient (r_s= .679, sig. .000, 95% CI.404-.884)



Variable	Min	Max	Mean	SD
Age (years)	23	77	43.80	12.42
Weight (kg)	45	131	69.28	17.20
Height (cm)	152	192	170.41	08.87
Flexion (degrees)	10	72	47.00	15.29
Extension (degrees)	28	86	58.47	15.00
Lateral Flexion right (degrees)	14	62	34.70	11.60
Lateral Flexion left (degrees)	18	60	37.73	11.29
Rotation right (degrees)	40	90	63.90	14.66
Rotation left (degrees)	30	90	58.90	16.84
Totalscore NDI (points)	0	30	11.10	06.20
Totalscore S-ROM-Neck patient (mm)	92	600	452.33	111.89
Totalscore S-ROM-Neck Assessor (mm)	256	600	459.63	87.63

Table 1: Baseline characteristicsof all participantsincludingrangeofmotion (ROM) measuresfor all cervicalspinemovements, S-ROM-Neck and Neck Disability Index (NDI-G) ratings.

	CROM / S-ROM-Neck (pt)	Sig.	95% CI	CROM / S-ROM (Ass)	Sig.	95% CI	S-ROM-Neck (pt) / S-ROM (Ass)	Sig.	95% CI
Flexion	.499	.005	.116-.792	.497	.005	.182-.772	.730	.000	.488-.886
Extension	.356	.054	-.007-.651	.734	.000	.490-. 866	.462	.010	.121-.705
Rotation right	.631	.000	.406-.802	.763	.000	.555-.859	.606	.000	.284-.799
Rotation left	.661	.000	.376-.836	.716	.000	.434-.868	.595	.001	.280-.805
Lateral flexionright	.382	.037	-.047-.740	.582	.001	.254-.834	.276	.140	-.152- .635
Lateral flexionleft	.371	.043	-.023-.661	.488	.006	.145-.730	.387	.035	.021-.685

Table 2: Correlationsof Flexion, Extension, Rotation (bothsides), Lateral Flexion (bothsides) ofthe CROM and S-ROM-Neck measures (patientandassessor) uncludingsignificanceand 95% CI.

Item	N	Minimum	Maximum	Mean (Median)	SD
Pain intensity	30	0 pt	4 pt	1.43(2)	.97 (.97)
Personal care	30	0 pt	2 pt	.13(0)	.43(.43)
Lifting	30	0 pt	4 pt	.77(0)	1.22(1.22)
Reading	30	0 pt	4 pt	1.47(1)	1.10(1.10)
Headaches	30	0 pt	5 pt	1.90 (2)	1.37(1.37)
Concentration	30	0 pt	3 pt	.80 (1)	.84 (.84)
Work	30	0 pt	3 pt	.83(1)	.79(.79)
Driving	30	0 pt	4 pt	1.34(1)	1.00 (1.00)
Sleeping	30	0 pt	4 pt	1.03 (1)	1.12 (1.12)
Recreation	30	0 pt	5 pt	1.47(2)	1.07 (1.07)

Table 3. Single item results of the Neck Disability Index (NDI) including minimum points (pt), maximum points, mean (median) and standard deviation (SD).

Variable	Min	Max	Mean	SD
Age (years)	33	77	51.60	13.14
Weight (kg)	51	86	71.70	11.46
Height (cm)	158	185	172.60	08.20
Flexion (degrees)	10	60	41.80	16.12
Extension (degrees)	28	80	53.60	18.32
Lateral Flexion right (degrees)	14	40	28.80	09.39
Lateral Flexion left (degrees)	18	50	34.60	12.89
Rotation right (degrees)	40	72	53.40	11.43
Rotation left (degrees)	30	80	53.00	21.15
Totalscore NDI (points)	5	30	11.50	07.29
Totalscore S-ROM-Neck patient (mm)	92	570	449.40	140.50
Totalscore S-ROM-Neck Assessor (mm)	256	548	430.80	99.56

Table 4: Baseline characteristicsofthetenparticipantstakingpart in an interview includingrangeofmotion (ROM) measuresfor all cervicalspinemovements, S-ROM-Neck and Neck Disability Index (NDI-G) ratings.